ECONOMIC ANALYSIS OF GUM ARABIC PRODUCTION IN YOBE STATE, NIGERIA

BY

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DEPARTMENT OF AGRIC. ECONOMICS AND EXTENSION

FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE.

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CERTIFICATION

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June 3, 2006
Date

DEDICATION

This research work is dedicated to my beloved wife, Yurama Wuranti (Mrs.) and my son Samuel Wuranti

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I wish to express my gratitude and thanks to Almighty God whose infinite mercy has seen me to this point in life. I wish to acknowledge with gratitude, the assistance given to me by my project supervisor, H.O.D and lecturer, Professor, A.G. Daramola to attain the standard of this work.

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ABSTRACT

This study seeks to provide information on the economics of Gum Arabic Production in Yobe State.

A sample of one hundred and twenty (120) gum Arabic farmers from seven (7) Local Government Areas (LGAs) where gum Arabic is grown in Yobe State was made. Primary data were collected using questionnaire to elicit needed information on production, revenue, resource use efficiency and constraints as well as solutions to the identified problems. The data were analysed using descriptive statistics, budgetry technique and the production function analysis.

The results showed that majority (73.33%) of the farmers were male and fall within the age bracket of 41 to 60 years. The farmers were operating on small-scale levels cultivating one to three hectares of land on the average. Family and hired labour were found to constitute the major source of farm labour with household size of between six and ten. A yield of 200kg/ha was recorded on the average by the farmers in the study area. Gross margin analysis indicated that, Net Farm Income per farmer per hectare was N19,430:00, implying that Gum Arabic production by small-scale farmers in Yobe State is profitable.

The empirical results of the production function analysis also revealed that the production variables (farm size in ha, experience in

years, transportation cost, in Naira) were statistically significant at 5% level and were positively related to farmers output.

The efficiency of resource used by farmers indicated that family labour was over-utilized in the production process and farm size was under-utilized. Again, farmers were observed to be operating in the stage II of the production process with a Returns to Scale of 0.29.

The findings identified problems faced by the farmers which include, long gestation period of the Gum tree, inadequate production inputs, lack of processing facilities, illegal tree cutting, and bush burnings and poor transportation network.

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1.0 INTRODUCTION

1.1 AN OVER – VIEW OF NIGERIAN AGRICULTURE

Nigerian agriculture performed reasonably well in the 1950s and the first half of the 1960s. Food production kept pace with population growth and agricultural exports provided more than 70% of the foreign exchange earnings. The sector provided the necessary raw materials for our domestic industries (Falusi,1990). In addition, it provided employment opportunities to about 80% of the agricultural adult labour force. Its importance was underlined by the fact that it provided for about 70% of the total Nigerian food supply. Aromolaran (1983) noted that, the importance of this sector is also found in its contribution to the country's Gross Domestics Product (GDP).

Today, Nigerian agriculture is in crisis, steadily through the years production has declined. The relative contribution of agriculture to the nation's economy has declined drastically. Almost all the cash crops that were once the mainstay of export earnings are now produced in negligible percentage and sometimes had to be imported to meet the country's industrial need. The contribution of agriculture to the Gross Domestic Product (GDP) declined for the past ten (10) years. Also the general performance of the sector over the years has not been encouraging in relation to its contribution to the general economy of the country.

Factors responsible for the almost stagnant growing rate of agricultural production are believed to include the discovery of oil in the early 70s, and the neglect of the rural areas and hence industrial tree crops producers. Thus the country moved from an era of surplus in terms of agricultural production to become a major importer of food items and raw material, because the non-oil sector of the economy has stagnated, while crude oil revenues have not been managed effectively to stimulate desired growth levels and sustainable economic development (Aribisala, 1994). Furthermore, the decline has been because, succeeding governments have failed to appreciate the role of small-scale industrial tree crops producers. They have misguided belief that public sector programmes or large-scale mechanization farming constitute the only panacea to all the ills of the agrarian landscape.

It is against this background that informed the Federal government's decision to diversify the nation's economy in order to increase its sources of foreign exchange other than petroleum. The agricultural sector is still considered as the most promising alternative. The choice is informed by its constant renewable potentials, thus ensuring continuous supply of its outputs, enhancement of environmental qualities, and the natural resources on which agricultural productivity depends. In realization of the above goal and the attainment of rapid industrialization drive, the Federal Government, through the National Accelerated Industrial Crops Production Programme (NAICPP),

considered Gum Arabic as one of it's mandate cash crops for mass production (Okatahi, 1996).

Gum Arabic is the commercial dried exudates obtained by tapping the stems and branches of Acacia senegal or other related species of Acacia. The gum has various uses in the food, textile, print and pharmaceutical industries. Other important uses of Acacia tree include its use in the fight against desert encroachment and soil improvement. Some parts of the Acacia tree such as the barks, leaves and pods are used for medicinal purposes and in tanning and dyeing processes.

In Nigeria Gum Arabic trees occurs in the Sudan and Sahellian ecological zones which cover Adamawa, Bauchi, Borno, Jigawa, Kano, Katsina, Zamfara, Kebbi, Sokoto and Yobe States.

The Rubber Research Institute of Nigeria (RRIN), was in 1994 given the mandate by the Federal Government to conduct research into all aspect of Gum Arabic production. It was also mandated to apply the results of such findings or investigations to the promotion of Gum Arabic cultivation, harvesting, processing and utilization in Nigeria.

1.2 PROBLEM STATEMENT

Acacia tree has been identified as having a number of social, economic and environmental significances from which, the farmers in particular and the nation in general can derive a number of benefits.

The Sudan and Sahellian Agro-ecological Zones are characterized by low annual rainfall, high temperature, poor soils and generally lack of

vegetation cover. The above situation has limited the agricultural activities of farmers in these zones to the production of arable crops and rearing of livestock. This has made it almost impossible to grow economic tree crops, which requires more rain than is obtainable in the region. However, the Acacia tree, by its resilient nature has the ability to thrive in the Sudan-Sahellian zones. Infact, the bulk of the nation's reserve occurs in the wild in these agro-economical zones.

Furthermore, the problems of desert encroachment which has led to environmental degradation and poor soil quality status of the region can be addressed through the establishment of Gum Arabic plantations to act as shelter belts. In addition, the leaves of the Acacia trees are also known to be able to improve soil fertility thereby increasing crop yield. The seeds, leaves and pods can as well be fed to livestock like goats, sheep and camel as a source of protein. Considering the size of livestock industry in this region, this can help to reduce the cost of feeding the animals and thereby improving the nutritional status of the livestock.

The Gum which is the major by-product of Acacia tree has various uses in the food, textile, print and pharmaceutical industries. This therefore implies the existence of a ready market at both local and international scenes. Gum Arabic is currently exported from Nigeria to the industrialized nations like the United States of America, which imported 1,880 metric tones of Gum Arabic valued at $3,050,000 between 1992 and 1995, India in 1995 bought 2,542 metric tones of Gum Arabic valued at $1,150,025; and the European Union Countries

imported 3,683 metric tones of the product in 1995 valued at $5,956,000 (Lawal, 1998). Other importers of Nigerian Gum Arabic include Hong Kong and Japan. Infact, Olori (2002), estimated that the country can earn over $4 million annually from the exportation of Gum Arabic. It is also estimated that the nation has the potentials of controlling up to 30% of the world market of Gum Arabic.

Despite these numerous social, economic and environmental advantages for Gum Arabic production, the production of Gum Arabic is yet to be carried out on a large scale in form of organized plantations. The inability of more farmers to go into Gum Arabic production has resulted in the loss of most of these economic advantages.

The supply of Gum Arabic therefore lags behind it's demand, because the crop's full potentials had not been explored in the producing areas due to non awareness of improved practices. Poor cultural practices (the bulk of the Gum Arabic trees are still grown in the wild), product adulteration, low cash returns and non-regulated marketing process. The tapping processes have remained the same with the traditional methods over the years.

As a result of the above factors, there was little or no impact made on Gum Arabic production in Nigeria. In view of the above, this study analysed the economics of Gum Arabic production in Yobe State. The research effort seeks to provide useful answers to the following research questions:

(1). What relationship exists between certain socio-economic characteristics of the farmers and their production variables?

(2). What are the resource requirements and inputs used by the Gum Arabic farmers? and

(3). What are the major problems encountered by the farmers in Gum Arabic production?

I.3. OBJECTIVES OF THE STUDY

The major objective of the study is to undertake an economic analysis of Gum Arabic production in Yobe State.

The specific objectives are to:

1. examine the socio-economic characteristics of the farmers;
2. determine the profitability of Gum Arabic production in Yobe State;
3. assess the efficiency of resource use for Gum Arabic production; and
4. identify the major problems of Gum Arabic production in the study area.

1.4 HYPOTHESES OF THE STUDY

The following hypotheses are formulated for the study

Ho_1: There is no significant difference between costs and returns in Gum Arabic production in the study area.

Ho_2: Farmers are not utilizing their resources efficiently in the study area.

Ho_3: There is no relationship between some socio-economic variables of the farmers and their production variables.

1.5 JUSTIFICATION OF THE STUDY

The gap between demand and supply of Gum Arabic has been on the increase. Therefore the importance of increased Gum Arabic production cannot be over-emphasized.

This study seeks to investigate the economics of Gum Arabic production particularly as it relates to its production. Since the goal of any research is geared towards meeting the needs of the target population, it is thus important that research efforts starts with an appraisal of the economics of Gum Arabic production to the cultivators. What are the constraints as perceived by the farmers themselves. This situation is crucial to the attainment of the above aims of boosting Gum Arabic production in Nigeria.

CHAPTER TWO

2.O LITERATURE REVIEW

2.1 History of Gum Arabic Production

Acacia species was known as the most popular vegetations of the plant kingdom. Sean (1997) reported that, there were over one thousand one hundred (1,100) *Acacia* species worldwide. *Acacia senegal* and *Acacia seyal* were the dominant leguminous tree crops which belong to the family mimosaceae. This family is reported to have contained over three thousand (3000) species including *Acacia* senegal and *Acacia* seyal which remained the most commercially exploited species of the whole *Acacia* family. Both species were considered true *Acacia* Gum of African origin. The tree species as reported, grow in various plant communities in the drier parts of Africa and Asia. The true soluble gum as reported by Abdul (2002) procured in the Sudan (Chiefly from Kardofan Province) had been an article of commerce ever since the first century of the Christian era. It was then shipped to Arabian ports and then to Europe, where it was reported to receive the name "Gum Arabic"

The term "Gum Arabic was coined by European traders, who imported the products from Arabian ports such as Jeddah and Alexandria, and most gum traders of that time were associated with Arab countries Abdul (2002). The trade was routed along the River Nile from Sudan to Alexandria and later in 1906 to Suez on the Red sea when the railway was constructed to link Port Sudan to Khartoum. He further

stated that, the main ports of disembarkation were Trieste in Italy and Marseilles in France, from where the gum was distributed to the rest of Europe. Odo (1994) pointed out that, Sudanese Gun Arabic was mainly produced in the central parts of the country, when the principal world market was Ed-Dueim town on the White Nile. According to him, the Gum Arabic production was extended to Kordofan and Darfur, where the principal gum producing trees of *Acacia* senegal are the dominant component of the woody vegetation on light sandy soils. The remarkably good quality of the gum from these new areas mode the end users of Gum Arabic to often request to be supplied with Kordofan gum. This new terminology was applied to distinguish the Gum that was purely from *Acacia* senegal as opposed to that from other areas, which was occasionally adulterated with exudations from other trees.

Gum Arabic production as reported by Sean (1997) began with the Sudanese farmers, who tend and protected their very valuable trees throughout the year. Following their understanding of local conditions and expertise acquired over many years, the farmers tapped their trees. This involved wounding the trunks or branches using either a traditional tapping axe or the more recently introduced "Sunki", which looks like a traditional native hunting spear. Gum therefore exuded where the bark had been cut, and three weeks later the first Gum collection was made, up to three further collections could be made at three weeks intervals.

The commercial production of Gum Arabic occurred principally in the gum growing belts that lied on the southern periphery of the Sahara

desert, mainly between latitudes 11^{O} and 14^{O}. Sudan produced 26,000 metric tones of Gum Arabic in a year, out of which a total of between 4,000 and 5,00 tonnes were exported to United States and valued at $9million in 1996.

Ubi (1994) revealed that, more than eighty percent (80%) of the world Gum Arabic supply came from Sudan. The Sudanese considered Gum Arabic production as a traditional skill that had evolved over many generations, handed down from fathers to children. It had become an important aspect of life in the Sudanese Gum production belts and even more economic and social prominence. Experience had shown that Gum Arabic production evolved from the natural exudates from *Acacia* senegal trees, by tapping the trunk or branches in the wild to a more scientific agro-forestry operations that provided higher and more reliable yields as well as better quality of products.

Aghughu (1998) reported that, seasonal variation had a great influence on Gum Arabic production. The dry season had a higher potential Gum Arabic yield than its wet season counterpart. Higher yield were obtained after the rains were over and continued up to the first rain of the next year, approximately from October in one year till May or June in the next year. Low yield were as well observed during the period of the wet or rainy seasons where most of the trees were entirely green. Temperature as well was observed to have an influence on the time or season of Gum Arabic production. During the hot weather period, the leaves of *Acacia* senegal were observed to have exercised some

degrees of wilting, and shedding off their leaves indicate that the season for Gum Arabic production is at hand.

2.2 Gum Arabic Production in Nigeria

In Nigeria, Gum Arabic trees were considered as the most important economic plants in the Sudan – Sahelian ecological zones covering not less than eleven (11) states in the northern part of the country.

The production pattern within the Nigerian context as reported by (Ologhe, 1998) showed that, Gum Arabic were largely obtained in the wild, as far back as the 1960's and early 1970's. The former Borno State Government had made a substantial effort to plant and established Gum Arabic plantations. During that period under review, over Three hundred and thirty (330) hectares of land were cultivated. He added that, recently over Two thousand (2000) hectares were recorded as being cultivated in the major Gum Arabic producing belts of Yobe and Borno States. Other production areas as indicated include; Adamawa, Bauchi, Taraba, Kano, Jigawa, Katsina, Kebbi, Sokoto and Zamfara States. An average of five thousand (5,000) hectares of land was recorded as being cultivated in these states. (Aghughu, 2001).

Okatahi (1996) revealed that, between 1968 and 1979, a total of 48,966 tonnes of Gum Arabic were exported from Borno State in Nigeria. Also between 1980 and 1996, Gum Arabic export figures rose to about 4,500 to 5,000 tonnes annually, which gave Nigerian government an

average foreign earnings of between U.S $11.25 million to U.S $12.5 millions or N0.96 billion to N1.0 billion respectively per annum. He also noted that, Nigeria was considered second world producer of Gum Arabic to Sudan with an annual production of 5000 to 6000 metric tonnes of both *Acacia* senegal and *Acacia* seyal. The annual export volume was estimated to stand at 7000 to 8000 metric tonnes of both *Acacia* senegal and *Acacia* seyal respectively. The principal destinations of Nigerian Gum Arabic exports were the European Union (EU), India, USA, Japan and Hong kong. Export of the product to USA from 1992 to 1995 stood at about 1,880 metric tonnes valued at U.S. $ 3,050,000.

Aliyu (1998) noted that the demand for Gum Arabic product by the world industries has increased tremendously over the years. He mentioned that, In 1995 Gum Arabic export to the European Union stood at 3,683 metric tonnes valued at US $5,956,000 while India imported 2,542 metric tonnes valued at $1,150,025. The European Union was considered as the major importer of raw Gum Arabic from Nigeria followed by India and U.S.A. Other importer of course, included Hongkong and Japan.

2.2.1. **Production Areas of Gum Arabic in Nigeria**

Having considered the increasing demand for Gum Arabic products at the world market, it is worthy to note that efforts were made by the various levels of government in Nigeria, to go into more organized plantation establishment of Gum Arabic. Okatahi (1996) reported that

Gum Arabic production can be carried out on economic scale in the following states of Sudan and Sahellian zones of Nigeria. These states and the type of Gum grades produced are: Adamawa grade one type and three, Bauchi grade one, two and three, Borno grade one and two, Jigawa grade one and two, Kano grade one and two, Kebbi grade three, Plateau grade two, Sokoto grade three, Yobe grade one and two, Zamfara grade three and Taraba two and three.

Kano State was observed to be the major trade centre for Gum Arabic products while as Jigawa State was reported to be the largest collector of Gum Arabic in Nigeria. Over eight hundred (800) hectares of grade one Gum Arabic has been tested and sampled by the Importer Service Corporation (ISC) in Jigawa State. This was found to be in line with grade one good quality Gum Arabic that had been added. Bello (1998) reported that ISC was committed to purchase the entire 2002 Gum Arabic products produced in Jigawa State valued at about U.S. $400,00:00. The Atlantic Gums Corporation had also promised to assist Jigawa State Government in training Gum Arabic harvesters in the state. They also promised to supply some technical inputs to expand Gum Arabic production programme with 500,000 hectares in a year and 6 million hectares in 10 years time.

2.3. ECONOMIC IMPORTANCE OF GUM-ARABIC.

2.3.1. Gum Arabic as a source of Foreign Exchange

Gum Arabic played a major role in foreign exchange earnings. Aliyu (1998) reported that between 1980 and 1996, Gum Arabic export

was estimated to be about 4,500 to 5,000 Metric tonnes annually which gave Nigerian Government an average foreign exchange earnings of between US $ 11.25 million to and US $12.5 million per annum. Olori (2002) quoted the Food and Agriculture Organisation (F.A.O.) as estimating that Nigeria can make over $4 million US dollars annually from the export of Gum Arabic. Also because of the demand for Gum Arabic by international industries, it has made the product an international commodity. Currently, Importers Service Corporation reported that over 70% of the world supply of Gum Arabic is produced and exported by the Sudan (ISC 2002). Other major producers identified by ISC and Din (2002) included Nigeria, Niger, Senegal, Chad, Mali and Ethiopia.

2.3.2. Industrial Uses Of Gum Arabic

Gum Arabic has been found to have various industrial applications which include food, textile, and pharmaceutical industries. Okatachi (1996) reported the uses of Gum Arabic in the food industries, which include among other things; as emulsifier, stabilizers and binding agents for ice creams, chewing gums and in the manufacturing of jellies and jams. In beverages, it is used as foam stabilizers for beer and soft drinks. It is an emulsifier in flavouring extracts and fruit concentrates such as orange, lemon and cola drinks. It is a creaming agent for milk. Importers Service Corporation (ISC) (2002) reported that, in the pharmaceutical industries, Gum Arabic is used in the manufacture of capsules, to coat pills and also used in the manufacture of vitamins and lotions. It is also used in the

production of ink, water colours, paints, carbon papers, pottery and insecticides.

2.3.3. Environmental Protection

The Sundan-Sahellian ecological zones to which Gum Arabic is adapted in Nigeria is severely proned to ecological problems as a result of human activities such as fuel wood extraction, bush burning, over grazing, shifting cultivation and deforestation. The above human activities in such regions perhaps hampered the existence of tree crop plantations because they require greater amount of rainfall than is obtainable.

Gum Arabic based on it's hardy nature has been used to check desertification in some parts of the region. Olori, (2002) opined that desert encroachment problem which have threatened the lively-hood of inhabitants of the greater part of the Northern States can be arrested through the growing of Gum Arabic bearing trees. Okatahi (1996) noted that rocky lands, sand dunes and marginal soils that support little or no vegetation can be planted with Gum Arabic trees due to its ability to thrive well under such conditions.

Duke (1997) reported that, a particular species of Gum Arabic tree Acacia albida has the potential of improving soil fertility through droppings of its leaves during rainy season, thereby increasing crop yield of other crops intercropped with the Acacia. This serves as an economic importance to most farmers in the Northern parts of the country. He added that the dried, dead and thorny branches of the tree are used as natural barbed fences which serves to demarcate and protect farm lands

and identify boarders of each farmers. This helps in protecting the farms from grazing animals during dry season when livestock feeds are in shortage.

2.3.4. Livestock Feeds

Din (2002) highlighted the use of Acacia leaves and pods as a good source of livestock feeds during the dry season. Livestock rearing is one of the activities engaged in by farmers in the Northern part of the country. Therefore Gum Arabic production has provided opportunity of reducing the costs of feeding the animals.

2.4. CONCEPTS OF PRODUCTION FUNCTION

2.4.1. Production Function

The production function portray the input-output relationship. The relationship describes how resources (inputs) are transformed into product (output).

Implicit production function can be represented by the equation

$Q = f(x)$

$f(x)$ = Factors of production

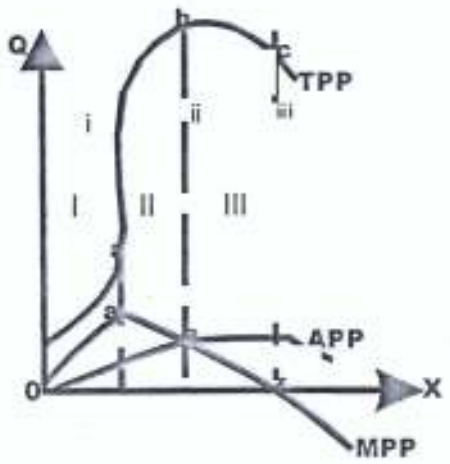
$Q = f(X_1, X_2, X_3, \ldots X_n)$

Where Q = Output

$f(X_1, X_2, X_3, \ldots X_n)$ = Variable and other fixed inputs.

The production function gives the boundary between uneconomic region and impossible region of output shown in figure 1 below.

Fig 1 **Production Function Graph**



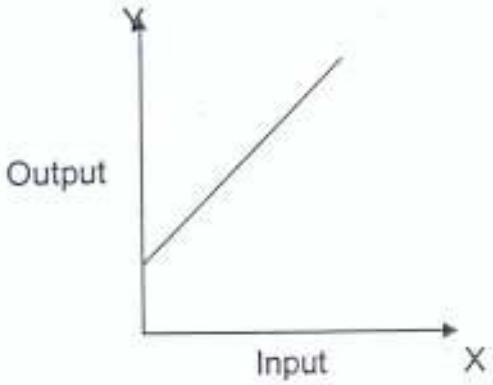
From Figure 1 above. It can be deduced that at Stage I Total Physical Product (TPP) is increasing at an increasing rate, Average Physical Product (APP) is also increasing and Marginal Physical Product (MPP) is at maximum. In Stage II, the TPP is increasing at an decreasing rate and APP is equal to MPP and at this point profit is maximized. In Stage III APP decreases at decreasing rate and MPP is negative.

The input-output relationship has three effects in the product.

(1). **Constant Marginal Return**

This refers to the percentage change in input (X) that could lead to the same percentage change in the output (Y) as represented graphically below.

Fig 2 **Constant Marginal Return Graph**

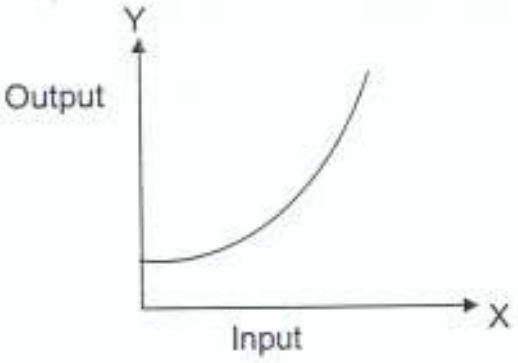


Source: Alfred (1982)

(2). **Increasing Marginal Return**

This refers to the situation in which an additional unit of a variable input will result to a proportionally large increase in the unit of output than the preceding unit of input. It is represent in Fig 3 below

Fig 3 **Increasing Marginal Return Graph**

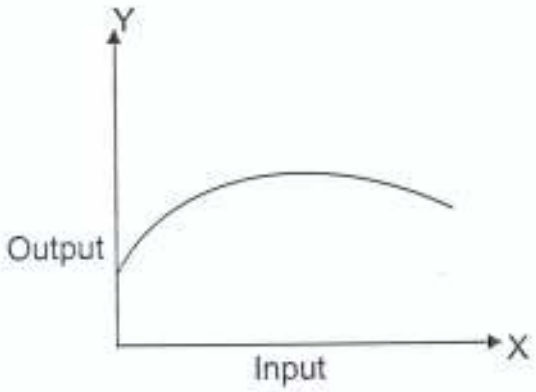


Source: Alfred (1982)

(3). **Diminishing Marginal Returns**

This applies when Marginal Physical Product (MPP) increases up to a certain point as more variable input is added to the fixed input, After certain point it begins to decrease as shown in Figure 4 below.

Fig 4 **Decreasing Marginal Return Graph**



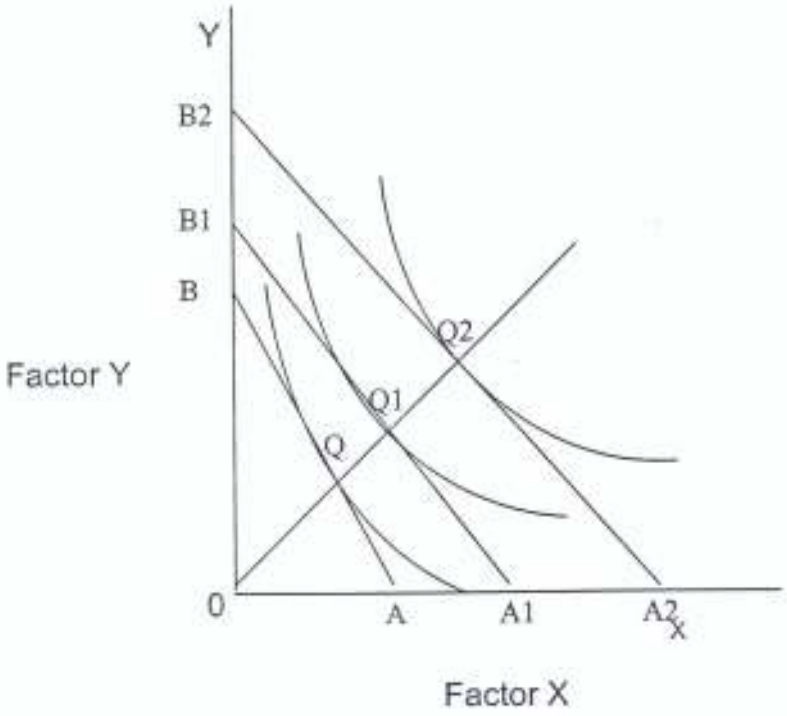
Sources: Alfred (1982)

2.4.2. RETURN TO SCALE

In production function, return to scale implies the appropriate combination of two or more factors of production to yield proportionally equal outputs. It is represented by the isoquant graph where equal product curve is tangential to the relevant price line.

The cost function model is derive from production function,

Fig 5 **Return to Scale Graph**



Source: Alfred (1982)

Assuming one has two factors of production X and Y, if he decides to alter his production then he must analyze the prices of the factors of production X and Y that is by dividing price of X and Y i.e.

$\frac{OB}{OA} = \frac{OB1}{OA1} = \frac{OB2}{OB2}$, therefore

If he wants to produce 20 units of product, this will be at equilibrium at point Q1 on the product curve.

2.4.3 Cost Function

This refers to the value of inputs used in producing a product in a given period. It helps the producer to determine the most profitable level of production as well as the level at which production must cease. It also helps in production decision making. The cost function model is derived from production function.

Q = f(x) Therefore, cost function is given by

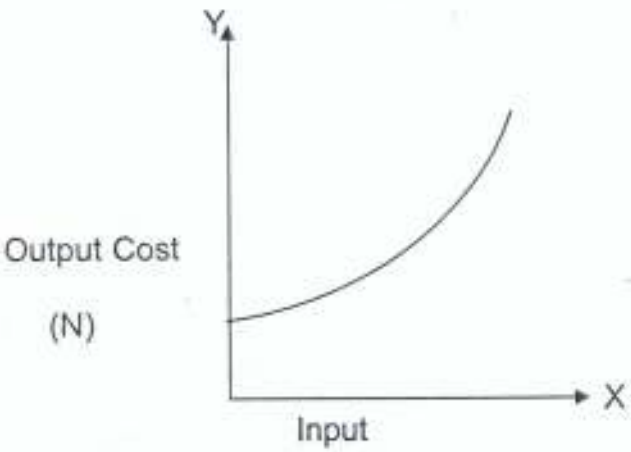
Q = f(Px.X) where

Px = Prize of input x

Q = Output

Graphically, this can be shown below.

Fig 6 **Cost Function Graph**



Source: David (1993)

2.5. CULTURAL PRACTICES IN GUM ARABIC PRODUCTION

2.5.1. Soil and Climatic Requirements

Aghughu (1998) reported that Gum Arabic is adapted to entisols and inceptisols soil types. He described the soil as sand, droughty soils, low in organic nitrogen and having low cation exchange capacity. He further added that the crop can tolerate a wide mean annual temperature of between 14°C and 43°C and rainfall as high as 800mm annually. Best performance was recorded from areas with a mean annual rainfall of 300-450mm annually.

In addition to the above, the marginal soils and the low annual rainfall which are characteristic of the Sudan-Sahellian zone can be harnessed through the production of Gum Arabic.

2.5.2. Field Establishment Of Gum Arabic

Gum Arabic production commences from the nursery phase where seedlings are raised in a potting mixture that contains two(2) parts of top soil, 2 parts river sand and 1 part of farmyard manure (cow dung). To promote vigorous seedling growth and development, Aghughu (1998) recommended the addition of compound fertilizers such as NPK and P_2O_5 .Other measures that could hasten germination includes soaking the seeds over night in tap water or boiled and cooling it to room temperature before sowing. Okatahi (1996) recommended that filling of the pots should be completed by the end of April, water it for few days to allow the soil stabilized before sowing commences in May. This allowed adequate seedlings development before transplanting in July, during which the rain would have been well established in most parts of the northern states. He added that treatment of the soil with chemicals such as dieldrex at a concentration of 1:150mls of water will prevent termites from attacking the seedlings. Seed germination is observed from 7 days to 21 days after planting. The planting depth of 1cm is recommended at the nursery site. Watering of the pots is recommended on daily basis after sowing using watering can.

2.5.3. Transplanting

Transplanting of young seedlings from the nursery to permanent field commences 3 months after planting. Okatahi (1996) recommended that root pruning could be carried out if transplanting is delayed to 5 and 12 months respectively. The delay in transplanting however as recommended by Aghughu (1998), who recorded the survival rate of 93% is the ideal period for transplanting. This is done in the month of July-August when the rain is steady to avoid seedling failure.

2.5.4. Spacing

Okatahi (1996) recommended a spacing of 4m x 4m giving a population of 600 trees/hectare. The seedlings are planted 30cm depth and 15cm wide in a hole. Watering of the seedlings should be carried out between the months of September and November when there is shortage of rainfall.

2.5.5. Inter-Cropping

This involves the planting of second crop between Gum Arabic trees. The second crop matures and are harvested before Gum Arabic attain its tappable stage. Okatahi recommended that short season crops such as soya beans, millet and sorghum are planted between rows of the seedling. Duke (1997) noted that farmers while waiting for Gum Arabic to mature, could generate additional income from their farms through these arable crops.

2.5.6. Tapping And Collection Of Gum Arabic

Tapping commence during the early part of drying season at the on-set of harmattan when about 50% of the leaves are shed from the tree when it is shaken. This is in line with the findings of Odo (1994) who insisted that greater amount of Gum is induced by hash environment. He added that the period for tapping Acacia senegal is November to April as the tree starts yielding Gum from the age of 5years. Appreciable yield is however experienced when the tree is about 15 years old. The commonest approach used to check whether the plant is ready for tapping is to shake the tree by it's stem or branch and observe the amount of leaf falls. The greater the amount of leaves fall, the more readily the tree is for tapping.

Although, there is dearth of information on the extent of debarking and depth of cut to allow for maximum Gum exudation, it is still recommended that the practice of the local people may be adopted for Gum Arabic tapping, paying particular attention to possibility of proper regeneration of the bark after tapping. The tapping can be done using any of the following instruments, (i). Tapping knife (ii) Tapping axe (iii) Tapping sickle and "sunki", which looks like a traditional native hunting spear. The instruments are used in making cuts on the stems and branches of the trees. After the cuts Gum will start to ooze out in 2 to 5 days and two weeks later the first Gum collection is done, up to three further collections could be done at two weeks interval.

Exuded Gum should be allowed to dry properly on the tree bark before they are picked. If Gum is not well dried, it stands the risk of clumping together in the collection bow and forming a very good adhesive medium for sand particles and debris, which are undesirable. These affect the quality of Gum in the markets. Once well dried Gum are picked, they can be sorted out, graded and sold at the market.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter is concerned with the methodological aspect of the study. These include: the background information of the study area, sampling procedure and sample size, data collection and instrument for data collection, measurement of variables and analysis of the collected data.

3.1 The Study Area

Yobe state is located in the North-East of Nigeria. The state lies between latitudes 11° East and 12° North and between longitude 12° 30" and 13° East of the equator. It is bounded by Borno State in the East, Jigawa state in the West, Gombe State in the South and Niger Republic in the North.

Yobe State has seventeen (17) Local Government Area (LGAs) with nine (9) major Gum Arabic producing LGAs in the state. These nine (9) LGAs that produce Gum Arabic are:- Damaturu, Gujba, Geidam, Karasuwa, Nguru, Yusufari, Kakusko, Fika and Bade.

The study area is generally characterized by tropical type of climate marked by two distinct seasons, dry and wet. The dry season starts in November and ends in March while the rainy season commence in April and ends in October. The mean annual rainfall is 1002mm with the wettest months being July and August. The driest months are December, January and February with a mean relative humidity of 15%

(annually). Maximum temperatures of up to 43.48°C are recorded between the months of January and April with minimum temperature of only 22.30 °C between the months of November and December

The topography of the area consist of valley with low lands, sloppy lands and sand dunes. The soil is generally loamy with clays accumulating in the valleys. The soil is suitable for agricultural activities and tree crops (Gum Arabic), Arable and livestock farming are undertaken in appreciable scale. Tree crops (Gum Arabic) and arable crop farming are the main agricultural practice in the study area. Crops like Gum Arabic, groundnuts, beans, rice, maize, sorghum, mango, and guava are cultivated in the area. Majority of the people are farmers (mainly small-scale). Other people engage in animal husbandry, fishing and hand crafting. Yobe State has many ethnic groups speaking different languages with Kanuri being the majority. Others include, Margi, Fulani and Hausa.

3.2 The Sampling Procedure and Sample Size

The multi-stage sampling procedure was used to select the respondents. Nine Local Government Areas (LGAs) that recorded the highest number of grade one Gum Arabic out of the seventeen (17) LGAs were purposively selected in the state. Seven (7) Local government areas were randomly selected from a list of the nine Local Government Areas in the state. Secondly, two villages were randomly selected from each LGA with ten farmers randomly selected from each of the selected villages. Hence, a total of twenty (20) farmers were selected

in each LGA which gave a sample size of One hundred and forty (140) farmers in the study area. However, a sample size of 120 farmers was eventually used for the study, these were the farmers who provided adequate information required for the survey in the state.

3.3. Data Collection and Instrument for Data Collection

Both primary and secondary data were employed for this study. Secondary data were the information obtained from literature review, project reports, official documents, publications and library materials among others. The primary data were collected through the use of a structured questionnaire consisting of both open and closed-ended questions to elicit information from the targeted respondents. Trained enumerators from Yobe Agricultural Development Programme (ADP) who have the knowledge of the local clientele were used, in the collection of information required from the farmers on Gum Arabic production.

3.4. Measurement of Variables

The variables of this study include the socio-economic characteristics of the respondents such as age, gender, marital status, educational level, occupation, family size, religion, farm size and farm income.

The variable are measured as follows:

Age: Respondents were asked to state their ages in years

Gender: Respondents were assigned their appropriate sex i.e. male or female

Marital status: Whether the farmers are single, married, widow, separated or divorced.

Educational level: They are classified as no formal education, primary school, post primary school and tertiary institution

Occupation: Respondents were asked to indicate their primary and secondary occupations

Family size: Respondents were asked to state the number of household members i.e. those eating from the same pot.

Farm size: Respondents were asked to state their actual farm size in local units which were later converted to hectares.

Farm Income: The farmers were requested to state the actual income realized from sales of farm produce as well as their farm output overtime.

3.5 Analytical Techniques:

The data collected were analysed through the use of descriptives, budgeting and production function analysis were employed

1. **The use of Descriptive Statistics**: This involved the use of measures of central tendency such as mean, frequencies, and percentages to explain the socio-economic variables of the respondents.
2. **Gross Margin Analysis:** The costs and returns involved in Gum Arabic production per hectare were determined by the use of gross margin analysis. This was done to determine the profitability of Gum Arabic.

Gross margin simply means the differences between the Gross Farm Income (GFI) and the Total Variable Cost (TVC).

That is;

$$GM = GFI - TVC$$

The Average Net Return (ANR) per kilogram and Net Return (NR) per producer was estimated using equations (1) and (2) below:

$$ANR = \left(\sum_{i=1}^{M} TRi\right)\left(Mi\right)^{-1} - \left(\sum_{i=1}^{M} TCi\right)\left(Mi\right)^{-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$ANR(TN)^{-1} = \left(\sum_{i=1}^{M} TRi\right)\left(\sum_{i=1}^{M} TNi\right)^{-1} - \left(\sum_{i=1}^{M} TCi\right)\left(\sum_{i=1}^{M} TNi\right)^{-1}\left(Mi\right) \quad \ldots\ldots\ldots\ldots(2)$$

Where

ANR	=	Average Net Return Per Producer
$ANR(TN)^{-1}$	=	Average Net Return per kg
TRi	=	Total sales revenue accruing to the ith producer
TCi	=	Total Cost incurred by the ith producer.
Mi	=	Number of Producers
TN	=	Quantity of Gum Arabic produced by the producers.

3. **Production Function Analysis**

The production function for the Gum Arabic produced in the study area is inplicitly given by;

$Qg = f(X_1, X_2, X_3, X_4, X_5, X_6, U)$ ----------eqn (3)

Where

Qg = Quantity of Gum Arabic produced (kg).

X_1 = Cost of farm tools (cutlass, hoes axes) fixed. (₦)

X_2 = Age of the farmer (years)

X_3 = Farmer's experience in Gum Arabic production (years)

X_4 = Farm size (hectares)

X_5 = Cost of Gum Arabic tapping, guarding, collection and sorting (₦)

X_6 = Cost of Gum Arabic, bagging and transporting (₦)

4. Efficiency Determination

The Marginal Value Productivity (MVP) is given by MVP =MPP. Py

Where MPP = marginal product

Xi = mean input xi

Yi = mean output yi

Therefore MVP = Mpp. Py

Py = price of output yi per kg

Three functional forms of the production function were fitted for the analysis of the results. These are: Linear function, double–Log function and Semi-Log. They are explicitly written as:

(a) **Linear Function**

$Q_i = a_o + a_1 X_1 + a_2 X_2 + a_3 X_3 + a_4 X_4 + a_5 X_5 + a_6 X_6 + e$. ----------eqn (4)

(b) **Double –Log function**:

$\log Q_i = \log a_0 + a_1 \log X_1 + a_2 \log X_2 + a_3 \log X_3 + a_4 \log X_4 + a_5 \log X_5 + a_6 \log X_6 + e$ -

----------equ (5).

(c) **Semi –Log function**:

$Q_i = \log a_0 + a_1 \log X_1 + a_2 \log X_2 + a_3 \log X_3 + a_4 \log X_4 + a_5 \log X_5 + a_6 \log X_6 + e$ -----

----------equ (6).

Where;

a_0 = Constant

$a_1, a_2, a_3, a_4, a_5, a_6$, . are all coefficients of the explanatory variables that were estimated and

e = error term.

Where Qi = Quantity of Gum Arabic produced (kg).

b_0 = Constant term

X_1, = Age of farmers (years)

X_2, = Farm size (hectare)

X_3, = Cost of farm tools (₦)

X_4, = Family labour (man days)

X_5, = Hired labour (₦)

X_6, = Years of Experience in Gum Arabic production (years)

X_7, = Transportation cost (₦)

The linear function was chosen as the lead equation, as it gave the best fit based on econometric assumptions.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSIONS

In this chapter the data obtained from the study questionnaire were analyzed and presented. Aspects treated include; the socio-economic characteristics of respondents, costs and returns incurred, and the problems associated with Gum Arabic production in Yobe State.

4.1. Socio-Economic Characteristics of The Respondents

4.1.1. Age

Table 4.1. shows the distribution of the respondents based on their age groups. Few (20%) farmers fall within the youthful age group of 20 to 40 years, 73.33% were within the age brackets of 41 to 60 years and only 6.67 fall above the age of 61 years.

Table 4.1. **Distribution of Respondents by Ages.**

Age groups (Years)	Frequency	Percentage
20-30	10	8.33
31-40	14	11.67
41-50	54	45
51-60	34	28.33
61 and above	8	6.67
Total	**120**	**100**

Source: Field Survey: 2003

In other words, majority (73.33%) of the entire farming population fall within the age group of 41 and 60 years with mean age of forty-five years. This represents a virile age bracket for active farm operations. By implication matured people are more involved in Gum Arabic production than their younger counter parts. This could be due to their vigor, interest and enthusiasm, which serve as an impetus to embracing and accomplishing farming innovations. Beside, Gum Arabic production, like any other business also requires experience and managerial skill, which are associated with age.

4.1.2. **Sex**

From Table 4.2. majority, (77.5%) of the respondents are men (male) while the remaining 22.5% are women (female).

Table 4.2. **Distribution of Respondents by Sex**

Sex	Frequency	Percentage
Male	93	77.5
Female	27	22.5
Total	**120**	**100.0**

Source: Field survey; 2003

This above analysis implies that, men participated more in Gum Arabic production, than their female counterparts in the study area. The percentage of women participating in farming is low and this may be explained by the fact that women in the study area are mostly Moslems. By implication the Moslem women were mostly kept in "pudda" which may not allow them to participate actively in farming operations. As a

result they spend most of their time doing "house keeping" duties and taking care of their children. In addition, many women undertake handcrafting, such as pottery, calabash designs and decorations. Also other women are civil servants and many have little or no time to work on the farms.

On the other hand, the men have greater access to production resources including land to the detriment of the women. This is because men were generally considered as the head of the family.

4.1.3. Marital Status

Based on their marital status, majority, (75.83%) of the farmers are married, 17.50% are single and only 6.67% are widowed. (Table 4.3)

Table 4.3. **Marital Status of the Respondents**

Marital Status	Frequency	Percentage
Married	91	75.83
Single	21	17.50
Widowed	8	6.67
Total	**120**	**100.0**

Source: Field Survey: 2003

The result above shows that married people are more engaged in Gum Arabic production than those who are single and widowed. This may be as a result of the availability of more hands to work on the farm coupled with more family responsibilities such as feeding, educating children, while the single farmers may have less responsibilities as compared to those who are married. Low level of involvement in Gum

Arabic activities by the widowed respondents may be explained, in part by the fact that most of them have no husband and may have little or no access to land. In most cases, they are catered for by their children and relatives.

4.1.4. Level of Education

Education has been observed to be positively correlated with the adoption of improved technologies. From Table 4.4, majority of the farmers some (52.5%) have primary school education and a few other 29.2% are observed to have secondary school education while the remaining 8% of the respondents went to tertiary institutions.

Table 4.4. **Literary Level of Respondents**

Literacy level	Frequency	Percentage
No formal education	12	10
Primary education	63	52.5
Secondary education	35	29.2
Tertiary education	10	8.3
Total	**120**	**100.0**

Source: Survey data, 2003

This result implies that level of adoption of innovations and the rate of increasing Gum Arabic productivity amongst the farmers may be expected to be high due to their high literacy level. This is also in line with the findings of Bakari (1992) who noted that educational level of the farmers and the use of mass communication method among other things

have a significant and positive correlation with adoption of modern farming practice.

4.1.5. Distribution of Respondents Based on Primary Occupation

From Table 4.5, majority (80%) undertake farming including Gum Arabic as their primary occupation while 20% have other occupation as a secondary occupation.

Table 4.5. **Primary Occupation of Respondents**

Occupation	Frequency	Percentage
Farming	96	80
Student	4	3.33
Others	20	16.67
Total	**120**	**100.0**

Source: Survey data, 2003

This explains why the area is described as agricultural area. The remaining 20% are engaged in other subsidiary occupation such as trading and fishing. This result suggests that majority of the people in Yobe state may be engaged in Gum Arabic production.

4.1.6. Family Size

As indicated in Table 4.1.6 23.33% have family size of one to five people, 26.67% six to ten household size, while 50% have family sizes above ten.

Table 4.6. **Distribution of Respondents by Household Size**

Family size (No. of household	Frequency	Percentage
1-5	28	23.33
6-10	32	26.67
10 and above	60	50
Total	**120**	**100.0**

Source: Survey data, 2003

It can thus be observed that majority of the respondents (50%) have family size of over ten (10) people with mean household size of eleven. These include children and other relatives. Having large family sizes, by implication may tend to suggest availability of farm labour among the farmers. This could lead to increased farmer productivity thereby encouraging them from reaping the economic of scale.

4.2.0 RESOURCE REQUIREMENTS AND SOURCES OF INPUTS UTILIZED BY GUM ARABIC FARMERS

4.2.1 Methods of Land Acquisition by Farmers

Inheritance is the dominant method of land acquisition in the study area.

Table 4.2.1 **Distribution of Respondents by Land Tenure**

Source of land	Frequency	Percentage
Inheritance	94	78.34
Rentage	19	15.83
Purchase	7	5.83
Total	**120**	**100.0**

Source: Survey data, 2003

Table 4.2.1 shows that 78.34% of the Gum Arabic farmers obtained land through inheritance, 15.83% acquired their lands through rentage and only 5.83% got theirs through purchase. The overall result could be low Gum Arabic production in the study area. The percentage of rented land is low as operated by only 15.83% of the farmers. Rental does not encourage the production of Gum Arabic because of the life span of the crop. Securing land under rent is a short-term arrangement, which could be applied to only one (year) cropping season. The disadvantage of inherited land on the other hand may lead to land fragmentation as the entire family continuous to increase in numbers thereby restricting the farmers from expansion of Gum Arabic Farms.

4.2.2. Distribution of Respondents According to Farm Size

As indicated in Table 4.2.2, majority of the respondents are small-scale farmers with a mean farm size of 2.8 hectares.

From Table 4.2.2, 21.67% of the farmers have farm holdings of less than one hectare, 72.50% have between one and three hectares, 4.16% have four to six hectares and 1.67% of the farmers have farm holdings of more than six hectares

Table 4.2.2: **Distribution of Farmers base on their Farm Size**

Farm size (ha)	Frequency	Percentage
< 1	26	21.67
1 – 3	87	72.50
4 – 6	5	4.16
Above 6	2	1.67
Total	**120**	**100.0**

Source: Field Survey data, 2003

This implies that most of the farmers in the study area are small-scale farmers.

Cultivating small farm holdings may have the inherent disadvantage of discouraging farm mechanization. It may also prevent the farmers from reaping the economic of scale and hence this will go a long way in explaining the persistence of poverty among the respondents.

The total land area put under Gum Arabic production in the area by the respondents only was found to be 338 hectares. The farms were

planted in different forms such as sole plantation, boundary planting and planting as hedges. Other reasons that could be responsible for the small size of Gum Arabic farms include, production of Gum Arabic on organized plantation is relatively new and as such farmers are still skeptical about committing large hectares of land to its production. This requires enlightenment campaigns on the numerous social, economic and environmental importance of Gum Arabic production.

By implication, farmers are now shifting from the habit of collection Gum Arabic from the wild to a conscious effort at scientific method of Gum Arabic cultivation. This development of scientific agro-forestry approach to Gum Arabic production will provide higher and more reliable yield as well as better quality products for international market.

4.2.3. Annual Gum Arabic Yield on Farmers Field in the Area (Kg/ha).

Table 4.2.3 below shows that some 30% of farmers recorded yield of between 100-150 kg/ha/yr on their farms, while 70% got yield of between 151 and 200kg annually.

Table 4.2.3: **Distribution of farmers by their level of output (kg)**

Yield (kg/ha/yr)	Frequency	Percentage
100-150	36	30
151-200	84	70
Total	**120**	**100.0**

Source: Field Survey data, 2003

However, no yield was recorded from the new plantation that was planted two years earlier. Beside some old plantations were observed to

have low yield due to problems such as old age, fire outbreak and poor tapping skill or techniques by the farmers in the study area.

4.2.4 Labour Source

Labour source	Frequency	Percentage
Family labour only	8	6.67
Hired labour only	38	31.67
Family and hired labour	62	51.66
Family and Communal labour	12	10.00
Total	**120**	**100.00**

Source: Field Survey data, 2003

Table 4.2.5 shows that 6.67% of the Gum Arabic farmers used family labour only as their source of labour, 31.67% use hired labour only while 51.66 percent of the farmers combined family and hired labour. It is therefore clear that the dominant source of labour in the study area is family and hired labour.

Table 4.2.5. **Labour Input Per Hectare Under Gum Arabic Production in Yobe State.**

tions	Family labour (Man-days)	%	Hired Labour (Man-days)	%	Total Labour	%
ng	0	0	6	10.71	6	10.71
ling	2	3.57	18	32.14	20	35.71
sting/Collection	7	12.50	10	17.87	17	30.37
g	3	5.36	4	7.14	7	12.50
ng and bagging	2	3.57	4	7.14	6	10.75
	14	**25**	**42**	**75**	**56**	**100**

Source: Field Survey, 2003

Table 4.2.5. Shows that Guarding after tapping of Gum has the highest number of Man-days required per hectare spent. This is to allow the Gum to dry properly before harvesting. As a result, pilfering of Gum Arabic is prevented before drying. Adequate guarding is required. These suggest that guarding and harvesting of Gum are the most labour demanding operation in Gum Arabic production.

4.3.0 Costs and Returns in Gum Arabic Production Per Hectare

Table 4.3.1. **Average Cost and Returns per Hectare per Farmer of Gum Arabic Production in Yobe State.**

A. Variable Cost				
Variable	**Quantity**	**Unit Price (₦)**	**Value (₦)**	**% of Total Cost**
Family Labour	14 man –days	150:00	2,100:00	19.87
Hired Labour	42 man-days	150:00	6,300:00	59.60
Cost of Transport	4(50kg-bags)	120:00	480:00	4.54
Cost of storage	4(50kg-bags)	30:00	120:00	1.14
Loading and Off Loading cost	4(50kg-bags)	5:00	20:00	0.19
Total Variable Cost			**9,020:00**	85:34
B. Fixed Cost				
Land rent	1 hectare	500:00	500:00	4.73
Farm Implement (hoes, cutlass, axes, baskets and sacks).		1,000;00	1,000:00	9.46
Market Tax		50:00	50:00	0.47
Total Fixed Cost			**1,550:00**	**14.66**
Total Cost of Production			**10,570:00**	**100**
C. Returns				
Yield (Grade 1 Gum)				
Total Output		**200kg**		
Price per kg		N150:00		
Gross Return (GR)		**N30,000:00**		
Gross Margin (GR – TVC)		**N20,980:00**		
Net Profit (GR – TPC)		**N19,430:00**		
Returns to Naira Invested		N1:83		
Returns to Family Labour Invested		N9.25		
Returns to Hired Labour Invested		N3.08		

Source, Computed from Survey, data 2003

The average variable cost per hectare farmer was ₦9,020.00. This accounted for 85.34% of the total production cost. While the average fixed cost was ₦1,550.00 (14.66%) of the total production cost. Thus, total cost per farmer per hectare was ₦10,570.00. The Gross Return (GR), Gross Margin (GM), and Net Farm Income or Profit (NFI) per hectare were ₦30,000.00, ₦20,980.00 and ₦19,430 respectively. It can therefore be seen that Gum Arabic production under the small-scale production is profitable in Yobe State.

The Returns to Naira invested revealed that, for every one Naria (₦1.00) spent by the farmer on Gum Arabic production during the period under study, the farmer makes a profit of ₦1.83. Also for every one Naira (₦1.00) he invested on Family labour each time he engages them on the farm, he makes a profit of ₦9.25. Also, for every one Naira spent on hired labour and transportation of products to the market, he makes a profit of ₦3.08 and ₦40.48 respectively.

Therefore, Hired labour in Gum Arabic production in the study area is more costly than the family labour when compared to their returns.

4.4.0 Production Function Analysis

In order to determine the factors affecting Gum Arabic output (Y) of the small scale farmers in Yobe State, the output (Y) of the farmers was regressed on some variables such as age (X_1), farm size (X_2), cost of farm tools (X_3), family labour (X_4) hired labour (X_5), farming experience (X_6) and cost of transportation (X_7)

The linear function was chosen as lead equation and for discussion because it gave the best fit, (Table 4.4.1).

Table 4.4.1. **Regression Analysis of the Production Function of Gum Arabic in the Study Area**

Variable Name	Regression Coefficient	Standard Error	T-Value
Constant	144.911	84.112	1.723
Age of farmers	- 0.613	0.403	- 1.520
Farm size	11.954	3.152	3.793*
Cost of farm tools	- 0.017	0.012	- 1.465
Family labour	0.330	1.296	0.254
Hired labour	- 1.186	1.830	- 0.648
Years of Experience	1.977	0.886	2.231**
Cost of Transportation	0.247	0.020	12.148*

$R^2 = 0.73$

Adjusted $R^2 = 0.71$

F – Ratio = 43.73*

* Significant at 1% level

** Significant at 5% level

Source: Computed from Survey data 2003

Table 4.4.1. above reveals that, farm size, years of experience in Gum Arabic production and cost of transportation are the significant production variables that determines the level of Gum Arabic output in Yobe state. These variables were significant at 5% level with an F-ratio of 43.73. An R^2 value of 0.73 was obtained which implies that about 73% of the variations observed in Gum Arabic Output are jointly determined or

explained by these independent variables. Also, the standard errors of the estimates are generally low, ranging between 0.02 to 3.152. This suggests that the sample size is also reasonable and was taken from a normally distributed population.

The implication of the coefficients of the independents variable above can be explained. The age of the farmers (X_1) have a negative but not significant coefficient, which is in agreement with a priori expectation and implies that an inverse relationship exists between the age of farmers and the level of output or farm income. In other words, young farmers tend to have more output as they would be willing to try new innovations which could result into higher output and by implication higher farm income. However the relationship was not significant. On the other hand, a positive and significant relationship exist between the farm size and the farmers' output. Thus the larger the farm size, the larger the output and by implication the higher the farm income. There existed a negative but not significant relationship between cost of farm tools, hired labour use and farmers output. Also, family and hired labour were not significant in determining the level of output of farmers.

Three critical variables, farm size, years of experience and cost of transportation were significant in determining the level of output of farmers. The critical variables therefore in Gum Arabic production are farm size, years of experiencing Gum Arabic production and cost of transportation. Any policy therefore that will have direct bearing on these

variables will positively affect the level of output of Gum Arabic in Yobe state in particular.

4.5.0. Efficiency of Resources Used By Farmers

The Marginal Value Productivity (MVP) of each resources used in the production process of Gum Arabic was measured using the estimated regression. The Marginal Physical Products (MPP) were 11.954, 0.33 and 0.247 for farm size, family labour, and transportation of inputs respectively. The Marginal Factor Cost (MFC) were obtained from respondents responses.

Table 4.5.1 Marginal Value Products (MVPs) for Farmers

Input	MVP (₦)	MFC (₦)	MVP/MFC
Farm size	1793.1	500.00	3.5862
Family labour	49.50	150.00	0.330
Cost of transportation	37.05	120.00	0.309

Source: Computed from Survey data, 2003

With respect to the efficiency with which the various inputs were used, Table 4.5.1. shows that the MVPs for family labour the cost of transportation were less than their respective marginal factor costs or acquisition cost except farm size which had higher Marginal Value Product (MVP) than its Marginal Factor Cost (MFC).

This implies that Gum Arabic farmers in the study area over utilized family labour and transportation cost while they under-utilized farm size. As such farmers are inefficient in the use of their critical production inputs

of, family labour and cost of transportation. Any policy therefore that will encourage the farmers to increase their farm size and reduce labour and cost of transportation will positively affect their output of Gum Arabic.

Returns to Scale

Table 4.5.2. Elasticity of Estimate

Variables	Elasticity of production
Age	- 0.097
Farm size	0.163
Cost of farm tools	- 0.013
Family labour	0.0513
Hired labour	- 0.192
Farming experience	0.072
Cost of transportation	0.306
Returns to scale	**0.29**

Source: Computed from Survey data, 2003

From the table above, a Cobb Douglass function was fitted for estimating the Returns to Scale. This model was used because of ease of computation of the Returns to Scale of Farmers. From Table 4.5.2, the Returns to scale was 0.29 which implies that farmers are in stage II in the production function curve.

4.6.0 Major Production Constraints Faced By Gum Arabic Farmers

4.6.1. Labour Constraints

High cost of labour in the study area constituted a bottleneck to expansion of farm size. Most farmers (96%) could not pay for high wages demanded by the hired labourers and as such were forced to reduce the size of Gum Arabic farms.

4.6.2 Inadequate Supply and Distribution of Production Inputs

Production inputs like improved seedlings, agro-chemicals and tapping tools were not readily obtainable at government institution which has the mandate for the crop. Majority (76%) of the farmer complained even if they were available they were grossly inadequate to meet the needs of the farmers.

4.6.3 Poor Infrastructural Facilities

Poor roads and inadequate vehicles for efficient movement of Gum from the farms to the markets constitute another problem. Most farmers (91%) find it very difficult to transport their produce at the required time to the market especially during the harvesting period.

4.6.4. Lack of Processing Facilities

Grading and sorting of Gum were carried out manually as reported by 82% of the farmers and this is time consuming. The system is grossly inadequate to process Gum into the various required and accepted grades that attract good price at the international markets.

4.6.5. Long Gestation Period of the Gum Arabic Tree

Most farmers (83%) complained of the long gestation period of the Gum Arabic trees. The period ranged from five (5) to seven (7) years in Nigeria as against four to five years in Sudan. Farmers found it difficult to allow the land to be idle for five to seven years before tapping their Gums.

4.6.6 Tree Cutting and Bush Burning

Some farmers (56%) complained that, tree cutting for fuel wood, bush burning for hunting of games and the overgrazing by animals have drastically reduced the population of Gum Arabic trees in the study area.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

The chapter summarizes the findings of the study, draws conclusion thereafter and made recommendations based on the finding of the study.

5.1 Summary:

Nigerian agriculture performed well in the 1950s and first half of the 1960s. Food production kept pace with population growth and agricultural exports provided more than 70% of the foreign exchange earnings. The sector provided raw materials for domestic industries. In addition, it provided employment opportunities to about 80% of labour force. Today, Nigerian agriculture is in crisis, production has declined and contribution to the nation's economy has declined. The causes of these problems was the discovery of oil in the early 70s and the neglect of the rural areas and agriculture. Gum Arabic is used in a number of industries which include food, pharmaceutical, textile and the print. Other areas of usage include environmental protection. Despite the numerous social, economic and environmental advantages for Gum Arabic, its production is at rudimentary level. The study generally seek to undertake the economic analysis of Gum Arabic production in Yobe State.

The production pattern within the Nigerian context showed that, Gum Arabic were largely obtained in the wild, as far back as the 1960s and early 1970s. The productions areas covered the Sudan-Sahelian

ecological zones in the Northern States of the country. These states include,Adamawa, Bauchi, Borno, Jigawa, Kano, Katsina, Kebbi, Sokoto, Taraba, Yobe and Zamfara.

A multi-stage sampling technique was adopted in selecting sample famers. Seven(7) LGAs were randomly selected in the state for study. Twenty(20) farmers were purposively selected in each LGA which gave a sample size of 140 farmers, but only 120 farmers were analysed. Both primary and secondary data were used. The primary data were collected through questionnaire administered on selected farmers while secondary data were collected from literature review, project reports, official documents, publications and other library materials. The data were analysed using, simple descriptive statistics, budgeting technique and production function analysis.

The findings from this study revealed that majority (73.33%) of the Gum Arabic farmers were male and fall within the age bracket of 41 and 60 years with mean age of 45 years. Most farmers (94%) were observed to be operating on a small-scale level having mean farm size of 2.8 hectares. The farmers were cultivating one to three hectares on the average. Majority (90%) of them were literate and married. Family labour was observed to constitute the major source of farm labour, with household size of between six and ten for the majority (92%) of the farmers. An average yield of 200kg/ha/ was recorded by the farmers.

The Gross Margin (GM) analysis indicated that, average cost per hectare was ₦9,020.00 which accounted for 85.34% of total production

costs. The Gross Return (GR), GM and Net Farm Income (NFI) per hectare were observed to be ₦30,000.00, ₦20,980.00 and ₦19,430.00 respectively. Thus, Gum Arabic production is profitable. Further analysis revealed that, for every naira invested by a farmer or Gum Arabic production, he makes a profit of ₦1.83.

The empirical result of the production function analysis revealed that the farm size, years of experience and transportation cost determined production level of farmers (significant at 5% level). They were all positively related to farm output.

The empirical result of the efficiency of resource used by farmers revealed that farmers were operating in stage II of the production function with a Return to Scale value of 0.29

Some identified problems militating against Gum Arabic production in Yobe State include long gestation period of the Gum Arabic tree, inadequate production input, labour constraints, lack of processing facilities, and bush burning.

5.2 Conclusion

The study has concentrated on the economic analysis of Gum Arabic production in Yobe State. A number of conclusions can therefore be drawn from a review of the major findings of this research. Labour resources are scare and expensive since farmers depend mostly on hired and family labour, which are competitive. Farmers were found to be

small scale cultivating land size of less than three hectares with annual gum yield of about 200kg.

Gum production in Yobe State is profitable. The production function analysis indicated that farm size, years of experience and cost of transports are the critical variables that affect the farm output and were statistically significant at 5% level. Though the production of Gum Arabic is profitable, effective production is still constrained by a number of problems, which need to be ameliorated. There is still high potential for increasing the production of Gum Arabic and making it more profitable in the study area.

5.3 Recommendations

Based on the findings of this study, the following recommendations are hereby made.

- High cost of labour in addition to inadequacy have made the farmers to operate on small scale level. Therefore, there is need to assist the farmers with loan to enable them hire labour during peak production season and expand their size of holdings. Farmer are advised to form themselves into cooperative society in order to obtain loans from the government.
- Adequate production inputs, such as improved seedlings, agro-chemicals and improved tapping tools should be supplied bearing the farmers in mind that they are poor resourced.

- There is need to construct better roads that would facilitate the evacuation of Gum from point of production to the markets.
- Government should provide adequate processing facilities to Gum Arabic farmers for the processing, and sorting of their products, as this will help in the international markets.
- Technologies should be developed on the genetic improvement of Gum Arabic. Such technologies should be disseminated to farmers in the Gum Arabic producing states. This will continue to generate constant stream of improved varieties of Gum Arabic, which will be distributed to the farmers. Farmers are also advised to plant arable crops in-between the Gum arabic farms.
- Government should come up with a consistent national development plan for Gum Arabic sector that would be used to check the illegal cutting of gum trees for fuel wood, bush burning and over grazing by nomadic Fulani herdsmen so as to maintain the natural population of Gum Arabic species that are grown in the wild.

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QUESTIONNAIRE

ON

THE ECONOMIC ANALYSIS OF GUM ARABIC PRODUCTION IN YOBE STATE, NIGERIA

Dear Sir/Madam,

You are pleased requested to assist this research by answering the following questions either by ticking and stating the appropriate information required where necessarily. However each piece of information required here is confidential and will be treated for research purposes only and not for any intimidation. I therefore solicit for your kindly cooperation.

Thanks

Wuranti Valla
(Researcher)

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE.

SECTION A: PERSONAL INFORMATION

1. Name of Respondent:_____
2. Local Government Area:_____
3. Age _____
4. Marital Status: (a) Single ( ) (b) Married ( ) (c) Widowed ( )
   (d) Divorced ( )
5. Sex (a) Male ( ) (b) Female ( )
6. Educational status: (a) No formal Education ( ) (b) Primary School ( )
   (c) Post Primary School ( ) (d) Tertiary Institutions ( )
7. Family size composition: (a) No of wives ( ) (b) No of Children ( )
   (c) Other relatives ( )
8. What is your occupation (a) Farming ( ) (b) trading ( ) (c) Student ( )
   (d) Others specify

   _____
9. Do you engage in other activities apart from farming? Yes ( ), No ( )
10. If yes, mention them (a) _____ (b) _____
    (c) _____

SECTION B: INFORMATION ON GUM ARABIC PRODUCTION

11. How many years have you been growing Gum Arabic Farm?
    (a) 1-5 years ( ) (b) 6-10 years ( ) (c) Above 10 years ( )
12. How many hectares of land do you use for growing your Gum Arabic?
    (a) Less than 1 ( ) (b) 1 – 2 ( ) (c) 3 – 4 ( ) (d) 4 and above ( )
13. How do you acquire land for farming or growing Gum Arabic
    (a) By inheritance ( ) (b) Rentage (hire) ( ) (c) both ( ) (d) others
    specify _____

14. How much does it cost you, if you obtained land through?

    (a) Rentage (N) _____

    (b) Hire (N) _____

    (c) Purchase (N) _____

15. Do you cultivate other crops apart from Gum Arabic? Yes ( ) No ( )

16. If yes, fill in the table below

Types of Crop grown Last year	Yields in 50kgbags/crop	Selling price per 50kg bag per crop

17. Which type of tools do you use in tapping Gum Arabic trees

    (a) Hoes ( ) (b) Cutlasses ( ) (c) Axes ( ) (d) Others specify_____

18. What is the source of your labour on Gum Arabic production?

    (a) Family ( ) (b) Hired ( ) (c) Communal ( )

19. How much does it cost you to engage the following labour on your Gum Arabic farm daily?

    (a) Family labour (N) _____

    (b) Hired labour (N) _____

    (c) Communal labour (N)_____

20. Do you tap Gum Arabic? (a) Yes ( ) (b) No ( )

21. If yes, how many weeks do you use in guarding before collection?

    (a) 1 – 2 weeks ( ) (b) 3 – 4weeks ( )

22. Supply the information needed about labour operation on Gum Arabic in the table below.

No	Operations	Family labour Man-days cost/Man-day (N)	Hired labour Man-days Cost/Man-day (N)
I	Cost of labour for Gum Arabic tapping		
ii	Cost of labour for Gum Arabic guarding		
iii	Cost of labour for Gum Arabic collection		
iv	Cost of Gum Arabic for sorting		
V	Cost of labour for Gum Arabic Grading		
vi	Cost of labour for Gum Arabic bagging		
vii	Cost of labour for Gum Arabic transportation		

23. How many 50kg bags of Gum Arabic per hectare did you obtain during the past session?

Marketing information Process

24. What is the selling prices of your Gum Arabic for the following grades

Grades of Gum Arabic	1kg (N)	10kg (N)	50kg (N)
I			
Ii			
Iii			

25. How many 50kg of Gum Arabic do you obtain last year production period?
26. Where do you normally sell them?
27. What are the problems do you generally encounter in Gum Arabic production

_____

_____

28. In what ways do you think government can help you to increase your Gum Arabic production.

_____

_____